REMOTE WIRELESS CONTROL AND SUPERVISION OF RADAR SPEED DISPLAYS AND INTELLIGENT TRAFFIC SIGNS

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Abstract

The paper presents speed indicator displays, intelligent traffic signs, and traffic counters with wireless-communication capability (via the GSM/GPRS network). It describes the possibilities and advantages of these devices, such as remote parameter-setting, real-time supervision and control of operation, remote access to the data stored, enabling the operator to respond quickly in every traffic situation.

Keywords
Speed indicator display, variable message traffic signs, GPRS, wireless/cellular technology

INTRODUCTION

A host of various electronic devices are used in road traffic, informing the traffic participants of the situation on the road, and gathering data on the traffic. Typical examples are: speed indicator displays, traffic counters, variable message signs (VMS) etc. With all such devices, it is necessary to control/supervise their operation, transfer the data gathered, and appropriately set the operating parameters. In earlier times, devices used for such purposes could not be controlled remotely, so in order to change any settings the operator had to come personally to the device each time, and perform the necessary operations. Modern devices of this type can be controlled remotely. All the control operations and the transfer of the data gathered can be performed directly by the operator in the control centre. Modern devices have changed primarily as regards the type of the communication through which the remote control is performed. The communication types used nowadays are the fibre optic-cable communication, radio communication (for example, via the analog VHF/UHF links, the TETRA digital system, etc.), wire-cable communication (for example, RS-485), and wireless communication. At the moment, the wireless communication based on the GSM/GPRS system is the most interesting one. In comparison with the wire- and optical-cable-communication, its main advantage is that no additional infrastructure has to be built; instead, the public GSM network is used. The disadvantage of using the VHF/UHF links is primarily the fact that a special network of repeaters has to be available and that the data transfer is analog; besides, this technology is already on the decline. If the repeater network is not appropriate, the signal coverage of the territory can be insufficient, while in using the GSM/GPRS network there are usually no such difficulties. As regards the use of the public GSM network, there are some reservations concerning primarily its reliability and safety [1], however, the experience gathered so far shows that such reservations are unnecessary.

PRESENTATION OF THE SPEED INDICATOR DISPLAYS, TRAFFIC COUNTERS, AND LED TRAFFIC SIGNS

A) Speed indicator displays

They are used to show the current average speed of the vehicles on the road. They serve primarily the purpose of calming the traffic – most drivers immediately slow down when they see the speed of their vehicle on the display. In most cases, such displays are installed in the vicinity of schools, hospitals, and homes for the elderly, as well as on dangerous road sections, etc.

Figure 1: A speed indicator display, connected to the GSM/GPRS network. Above the upper left corner, there is a radar detector. The GSM/GPRS modem and the antenna are installed within the casing of the device.

The speed values measured are not only shown on the display but also stored in the internal storage of the device. On the basis of the measurement data, analyses of the traffic at the site can be performed at some later point of time. It is possible to perform statistical analyses with regard to the following:

- the average speed within a time interval,
- the maximum speed within a time interval,
- the number of measurement values within a time interval,
- the percentage shares of the measurement values by speed classes,

- the number of times a specific value of speed has been measured (speed histogram)

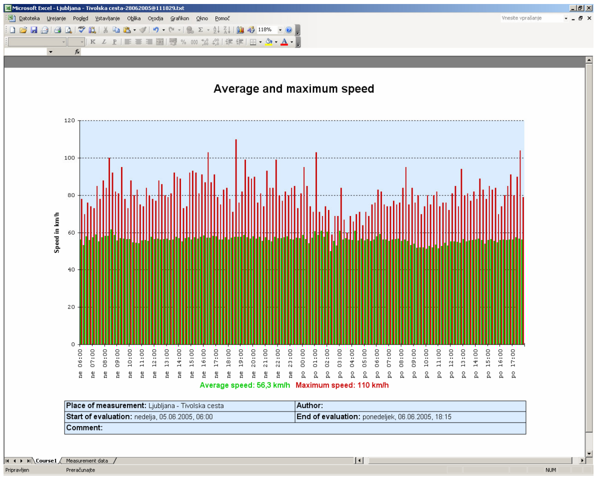

Figure 2: The diagram shows the average and maximum speeds measured, as a function of time

On the basis of such data, it is possible to carry out further actions intended to calm down the traffic or to plan the police surveillance activities and appropriate traffic signalling.

The speed indicator display consists of the following major units:

- microwave-radar detector,
- LED display,
- light sensor (luminosity meter) controlling the brightness of the LED display,
- motherboard with a data storage unit,
- GSM/GPRS modem,
- battery power supply,
- battery charger.

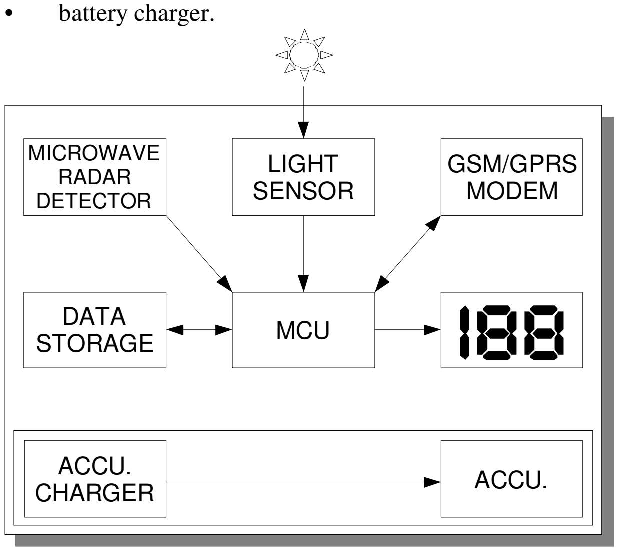

Figure 3: Block diagram of the speed indicator display.

Because the speed is measured by a microwave-radar detector, it is very simple to mount such a speed indicator display – there is no need to build inductive loops into the road etc.. All it takes is to mount the display on a street-light pole, for example, and the device can be put into operation. Also, it is possible to move the device to another location quickly and easily.

The in-built GSM/GPRS modem makes it possible to perform wireless remote control and supervision of the device, transfer the data stored, send alarms to the control centre etc.

B) Traffic counters

These devices are widely known nowadays. They are used to count the traffic, some of them also perform the function of classifying the vehicles by categories. The operation of older devices is based on the inductive loops that have to be built into the road. This solution presents some mounting problems, therefore it is relatively expensive. The maintenance is expensive too.

There is another solution available in the market today: traffic counters using microwave-radar detectors. Their advantage is that it is relatively very easy to mount them. Besides, practically no maintenance is required for these counters. Because the data are transferred wirelessly – through the GSM/GPRS network – the newest data, stored in the internal storage of the counter, are virtually always available.

On the basis of these data, equal statistical analyses can be performed as with the speed indicator displays; additionally, the data on the classification of vehicles are also available (motor-cycles, private cars, trucks).

C) LED traffic signs

On today's roads, there are more and more traffic signs equipped with LED diodes. The design of such signs makes it possible to display various contents/ meanings. Such signs also have a number of other useful features and advantages over the traditional traffic signs:

- variable contents/meaning of the sign,
- better visibility of the sign in darkness,
- automatic regulation of brightness, as a function of the brightness of the day,
- better visibility of the sign in various weather conditions (intense rain, snow, fog),
- a possibility of switching on the sign only if certain conditions are fulfilled (e.g., when the speed limit has been exceeded),
- in combination with the microwave-radar detector, it makes it possible to monitor the traffic, as well as to store and transfer the data,
- remote control and supervision,
- operation diagnostics.

On modern highways, such signs have become widely used. They can also be remotely controlled. In most cases, the communication is performed through wire cables and fibre optical cables because these are usually readily available on modern highways – usually they are built into the road at the time of the highway construction. On other types of roads, one of the main obstacles for the erection of such traffic signs is exactly the unavailability of appropriate communication channels between the traffic sign and the control centre. The advent of the GSM/GPRS communication technology has eliminated that problem.

THE GPRS CONNECTION BETWEEN THE DEVICES AND THE CONTROL CENTRE; PROGRAM INTERFACE

Within just a few years, the GPRS (General Packet Radio Service) – introduced in Slovenia in 2001 – has become a widely used, well tested technology of data transfer. The GPRS communication equipment has become reasonably priced, technologically advanced, and adapted for effective integration into a variety of systems. Also, the signal coverage has become sufficiently good in developed countries [2] (for example, in Slovenia more than 99% of the inhabitants are covered [3]). This situation makes it possible to use the GPRS technology more and more widely, for a variety of purposes (vehicle tracking, highway electronic toll-collection systems, telemetry, remote control of various devices …).

The GPRS technology operates in close connection with the Internet, so access to the Internet must be provided in the control centre. The Internet connection ideal for this purpose is the permanent one, making it possible to exploit all the possibilities offered by this technology. A major advantage of the GPRS over the older data-communication technologies, such as CSD and HSCSD, is that the devices are permanently on-line, enabling immediate access to the operator, who does not have to lose time by establishing the connection. In spite of the fact that the connection and the availability of the devices are permanent, the amount invoiced depends only on the actual quantity of the data transferred.

The signal strength of the network is satisfactory in most cases, allowing the use of a small antenna, which can be installed inside the casing of the device, protected from potential mechanical damage (caused during transportation or by vandals, for example). As regards the coverage and reliability of the network, the experience and data gathered during the last year in the wider area of Ljubljana show that the devices were connected to the network and accessible for more than 99% of the time.

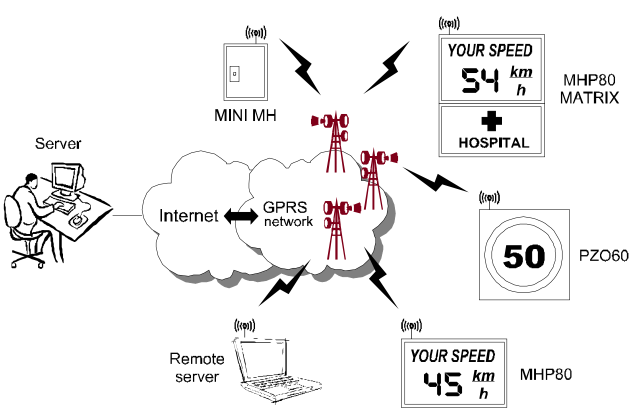

Figure 4: Control of the remote devices through the GSM/GPRS network.

The data transfer rate used between the devices and the control centre is up to approximately 20 kbit/s upstream and 50 kbit/s downstream. If compared with the increasingly widely used broad-band Internet connections, these speeds seem to be rather small, however, they completely satisfy the present requirements.

Description of the MHP software program

The software program used in the control centre is the MHP. It must be installed on a computer having access to the Internet. It is through this program and the Internet/GPRS network that all the communication between the user (superviser) and the devices, which are installed on the roads and connected into a network, is performed. This software functions as a server connected with remote devices – clients.

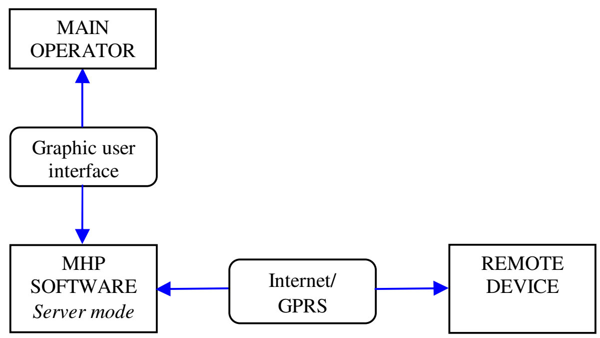

Figure 5: The local operator controls a remote device through the local server.

When the client is switched on, it connects automatically to the server, and remains connected with it. Many devices of various types can be connected with the server, therefore the device establishing a connection has to be identified first. Afterwards, the program adapts its operating parameters to the device type, or breaks the connection if the device type is not supported.

Every 5 minutes, the program sends a synchronisation request to every client, followed by the client's sending of data on its current status and power-supply voltage. If the program's operating parameters are set so, an e-mail with a status report is sent by the program to the maintenance personnel in case of a fault on a remote device. Consequently, the period during which the device does not function can be shortened. On the basis of the data on the power-supply voltage, the program plots a diagram, showing a potential weakening of the device's battery.

Also, the program makes it possible to set the following parameters of the remote devices: the connection parameters (the server's IP address and port, username, password, etc.) and operating parameters (the on/off status of the display, speed limits etc.). It is also possible to read various information about the functioning of the remote devices, such as the current brightness of the display, the speed currently displayed, etc.

A speciality of the program is that it makes it possible to remotely update the firmware of the client devices. Once a day, the program connects to the server and checks whether a new version is available; if necessary, the program updates the remote devices and itself.

If such function is supported by the device, the program can perform the transfer of the speed-measurement data temporarily stored in the device's memory. Afterwards, it transforms the measurement data into a form suitable for further processing.

The interface incorporated in the program makes it possible to prepare and transmit the graphic messages to be displayed, however, it is available only in the case that it is used to control a device with a graphic display. It is also possible to set the speed at which a picture or an animation is shown.

The program supports also the possibility that the operator connects to it remotely: a person working in the field can – using his/her computer and the same program (MHP) – connect to the server and take control of the remote device. This possibility is very useful on the occasions of mounting or maintaining the devices.

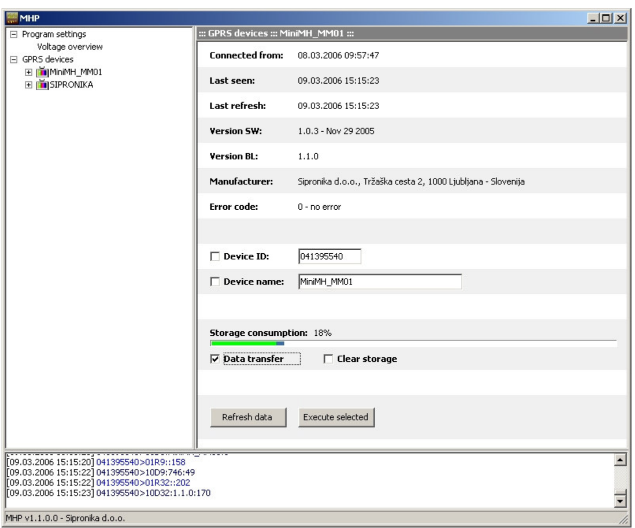

Figure 6: The main user-interface of the MHP program.

POSSIBILITIES OF FUTURE DEVELOPMENT

For the time being, the MHP server is intended for use in the control centre, from which the operator supervises the operation of the remote devices and sets their parameters. It would be possible to incorporate a WEB server that would receive http requests from remote web terminals, translate them into commands, and send these to the remote devices. So there would not be only one operator; this function could be performed by anybody equipped with a web browser and a password for connection to the WEB server.

From devices supporting such function, the program could daily transfer the traffic data and process them, as well as inform the operator and/or the road service in case it finds traffic irregularities.

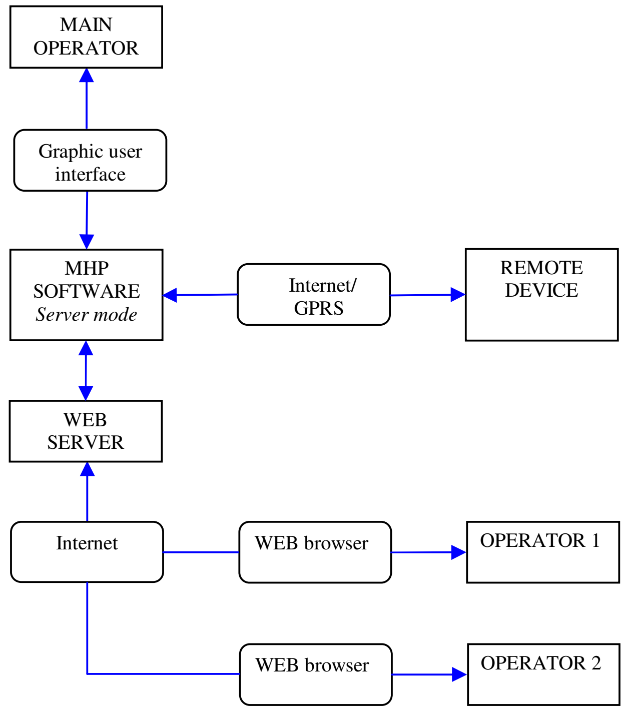

Figure 7: The remote operators configure the remote devices through the web browser. The local operator is in full control of the situation.

CONCLUSION

The GPRS has turned out to be a ripe technology of wireless data transfer, making it possible to remotely control and supervise modern electronic devices used in traffic control systems, in an economic way. The use of the GPRS greatly increases the choice of locations suitable for the installation of the devices because there is no need to build expensive ad-hoc communication infrastructure.

With an appropriate computer program (such as MHP), the remote devices are within the user's reach practically all the time. Also, this opens numerous new possibilities: on-line monitoring of the operation, transfer of the measurement data gathered, changing of the operating parameters, and remote updating of the firmware.

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REFERENCES

[1] http://www.suffolk.gov.uk/NR/rdonlyres/A2E030DD-938D-45F2-870B-E56FAE14AA2D/0/AppendixB.pdf

[2] http://www.coveragemaps.com/gsmposter_world.htm

[3] Data provided by the companies Mobitel and Simobil: www.mobitel.si; www.simobil.si